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JUNE 9, 1981

Physical Properties of Rocks

Ello Blasticiey, fracture, and flow THE EPIPET OF SIZE OF PECHANICAL PROPERTIES OF

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W.F. Brain (In perfects of Earth & Flancary Size Love, Massachusetts (1912) T.S.A.

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6110 Flastfrity, fracture and flow 18405 SCALE LABORATOR TEXTING OF HICPRULIC

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RESIDENCE STUDIES of Shelts Prove the LCHAND
RESIDENCE STUDIES of Shelts Prove the LCHAND
RESIDENCE SHELLING PRINCE

5. Frantile (Dept. of Colings and Geoglepales,
Univ. of Wincongle-Redison, Medimon, VI 53706)

R. Accioffs and M.F. Wang
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borobyle in Amydetforder, lee'hand con be characterized using direct observations with the 52%
and Coveration of volocity date. In the Tesland
benable, maither method prevides an accurate,
complete picture of the track appear tests appear
tion, but by using both 32% and investom date a
complete spectrum may be obtained. 52% observations provide information of high appear ratio
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by velocity invention Theory, while underity inversion theory gravides information on inv appear
tails venche (*.005) that are not inventy intails venche (*.005) that are not inventy in-

ratio rrache (c. 600) that are too astror to be toos with the filtr.

Alteration glas along tracks, hims unds, and aspect ration which imply closure promuses greater than the evitted stream all provide ori-dence that cracks are open in airs. Cracks rela-cident with graft boundaries, are shoulded, in the beault flots and segret me origin early in the rock's history, probably during conling. Crack-beating and alteration are observed to the read-with death, sension on the read to the readwith digit, emains a shift in creek show dis-tribution toward higher ampet antion. (Prices-nucle, beauty), wittendate relocity). J. Sacritye, Ret., Red. Faper 150012

GliO Equations of state

ADIASATS (37/3P), AND GRÜNEISEN PARAMETER OF

Bacl up to 50 Kbs and 860°C

Asinhard Soshier (University of California,
Institute of Geophysics and Planstary Physics,
Los Angeles, California 9002A)

The adiabatic pressure derivative of temperature (37/3P), of sedium chloride has been mansured by adiabatic compression up to 50 kbsrs
and 800°C using an end-loaded piston cylinder
apparatus with solid pressure medium. Our mansurements at room respectures are in vary good
agreement with occasivements using hydroxistic
fluid cells (Boshier et al., 1977). The results
can be rapresented by a power law relationship
between (37/3P), and volume of the form
(37/3P), (27/3P), p-0(V/V). We sertimate
powers not 6.1 and 5.1 at room temperature and
800°C, respectively. The Grünelsen parameter
can be calculated from the themsedynamic aquation y = K₀/T (37/3P), where K₀ is the adiabatic bulk modulus. 1 is found to be independent of temperature within our pressure and
temperature range.
J. Geophys. Res., Led., Paper 180370 temperature tange. J. Geophys. Res., Red. Paper 180570

6140 Magnetic and electrical properties PEDDE CHEMICAL REMAKENT MAGNETIZATION—A NEW DIMEN-SION IN EXPLORATION FOR SULFIDE DEPOSITS IN

SIGN IN EXPLORATION FOR SULFIDE DEPOSITS IN VOLCAMIC COVERED AREAS Lloyal O. Sacon (Consultant, 31) Viviso St., Han-cock, MI 49930) Charles L. Elliot Padox chemical remanent magnetization (CRN) results from current flow associated with a redox patential cell. An active redox call covered by later volcanics pay continue in operation for a partition as a continue in operation for a period of time, sufficiently long that the current flowing is the overlying voicentes will cause or smaller in the resolution of iron. The resolutional retirement is attu-on an attendance of sincial or by actual signation as a farrous hydroxide, with fixation at a higher Ex coarer the surface.

ids, with fixation at a higher Ex cearer the surface.

Bedox CRM will leave a characteristic pattern as a majoratic perpention where the surface is sensor in the rocks. Necessarement of the bagantic prok properties and interpretation of resulting patterns can be used to locate the ancient rocks reals. Redox calls in nature are unually sanctared with national surface deposits. Under appropriate conditions, redox face be utilized as an indirect method for suffide exploration. First secults for two purphers saftiste deposits and a sorveive sulfar deposits under approximately that of postules are all for deposits under approximately fastistics of this technique. Field tests in non-aulitude areas indicate that pervasive occurrence of false redox CRM spocalies do not area.

fairs reday CRN procedies do not exist except in the presence of sulfides. Laboratory experiments in the simulation of the redox CRN concept Rive support to the theory. Feephysics, Vol. 46, No. 8

6440 Thurmal properties
A RIPSIAN OF THE THEORY OF HEASIFIES THESMAL
OF THE THEORY OF HEASIFIES THESMAL
OFFICE THE THEORY OF HEASIFIES HIPSON
I. Moral (Lamont-Toberty Goological Chestvainty of Colombia Delucatily, Faliandes, R.v. 1994s)
The theory of memoring thermal diffunctive by
the modified Angurin's method is extended to the
case in which the ample 's return diffunctive bank diserpation occurs from its and sourface. The formulas
deriving the sample's thornal diffunctive, from
the amplitude decay and phase, in go of the temperone for a flat dist ample toy chick only (the
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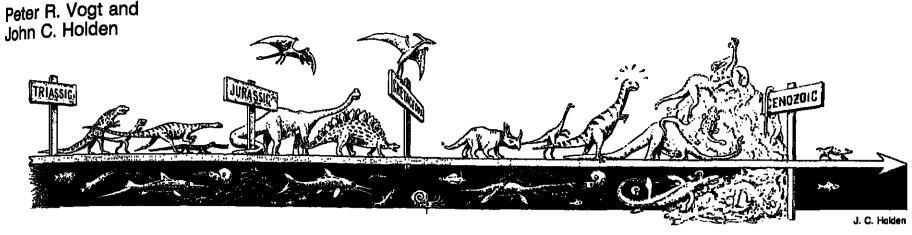
must be considered. For the flat dick sample, annearment at a single angular frequency of the Lemperature wave provides data necessary for the determination of the sample's thermal diffusivity. For the sample of finite diameter and length, however, measurements of temperature wave at two discrete angular frequencies are necessary to obtain a complate solution for the thermal diffusivity and other unknown constants. In both cases, to determine the sample's thermal conductivity and the surface conduntance of the sample's and surface, the heat capacity per unit volume of the sample must be known. Reasnalysis of experimental data on two luner sampless under atmospheric and vacuum conditions shows that for a rectangular paralislepiped, 1 x 1 x 2 cm size, the diffusivity values obtained by the new theories are within 5 percent of those derived by the conventional theory for a finite bar. Probably, the effect of the sample's geometry will become more distinctive if the samples are not allegated or flatter. The analysis also shows that progressively more refused data are required as the measurement theory becomes more confiltrated. (Thermin Inffusivity).

J. Geophye, Rea., Red, Faper 180707 . Geophys, Res., Red, Paper 180707

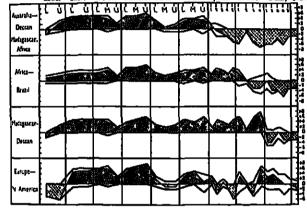
6190 Instruments and techniques SOREHOLE STUDIES OF ROCK ENGINEERING PROBLEMS IN LARGE SCALE LABORATORY EQUIPMENT Jask J. K. Damman (Department of Mining and Geological Engineering, University of Artmosa, Tucson, Arisons 85721) Gaulogical Inginearing, University of Artsona, Touson, Arisona 5772)

A testing facility which includes provisions for access to a co-axist bornhole in a cylindrical rock sample will provide the necessary means to atody a number of engineering generchances problems that can not be investigated readily with presently available equipment. Examples include the stability of deep borsholes; the scaling performance of well comenting and plugging; the influence of size, shape, stress gradient and energy concentration effects on rock failure about underground openings (almulating deep shafts and tunnels in hard intest rock); influence of discontinuities and rainforcement on opening stability; groundinteraction modeling of tunnel support machanics. Approximate ranges for desirable loading conditions (axial and lateral rock stress. Huid pressure and flow, temperature, geoduserical environment) are suggested for some of these problems as well as requirements for inhole instrumentation. A large scale laboratory tosting facility will find immediate due for the study of many important rock sungiers ing tunnel failures shaft onlinead.

5190 Instruments and tachniques HIGH TEMPERATURE TRIANIAL-TORSIONAL TESTING MANUFAR FOR CONCENTE AND BOOK Edgnak P. Bessur, John D. Hess and Samisi Melci Northweaters University, Svanston, Illingia 60201 Northweatern University, Evanatoh, Illinois, 60201
The purpose and design of a novel high-temper stury trightal tersional tenting metables for compares shy you in decayled. The temperature range is up to 600° the maximum exist look is 5 MH; the menigem confining pressure is libraried and the Merisan torque is 1555 Mt. The tention and the language of the menigement of the pressure is libraried and the Merisan torque is 1555 Mt. The tention and the language of **Extinctions: The Democratic Solution**



The problem of what caused the late Cretaceous extinctions still remains unsolved today (or does it?), after over a hundred years of inquiry supported by an ever increasing supply of theories and data. The classic approach of the multiple working hypotheses method to the problem of wholesale extinctions has apparently not succeeded, at least not until very recently.



An historical example of an 'opinion poll' in earth science: T. Aildi (*Handbook of Paleogeography*), Leipzig, 1917) used the statements or maps of 20 contemporary researchers to compile a table of votes for or against the existence of land bridges in the different geological periods. In Figure 1 of The Origin of Continents and Oceans (1988 Dayler addition to the Continen ans (1966 Dover edition translation of the original 1929 Gebr. Vieweg German edition), Alfred Wegener presented the results of this 'poll' in the graphical form reproduced here. The upper curve shows the number of proponents, the lower curve opponents, and the difference is hatched where 'for' and cross-hatched where 'sgainst.' Wegener argued—and most everyone agrees today— that the times of transition from 'for' to 'against' represent the times of continental breakup.

Transactions, American Geophysical Union

The Weekly Newspaper of Geophysics

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Caver. The Fourth Scientific Assembly of the International Asso-

dation of Geomagnetism and Aeronomy will be held August 3 to 15, 1981, in Edinburgh, Scotland, For more information, see page 541. (Reprinted with permission from The Times of London, personal column, Decamber 22, 1953.)

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^{unless} expressly stated.

What is the view of today's earth science community? To find out, we are soliciting your opinions in the accompanying poll. Of course the 'democratic solution' sought here cannot be considered the final answer to extinctions. But by taking the pulse of informed opinion, we hope to stimulate interest in the subject (of extinctions and of opinion surveys). The results of the poll will be reported in these pages at a later date. Whatever your specialty, please take a few minutes to fill out the questionnaire. We don't even

insist on your being an earth scientist, but do give us your professional specialization. Clearly, a hypothesis cannot be completely summarized in a short phrase. Treat each hypothesis as an approximation, and give your basic opinion. Please do not embellish

the hypotheses with qualifiers, except under 'other sugges-The questionnaires should be sent either to John C. Holden, Box 38, Winthrop, Washington 98862 or to Peter

R. Vogt, Port Republic, Maryland 20676. We feel the tide of scientific opinion should be routinely gauged, particularly at times of rapid change. Tragically, no opinion surveys were conducted during the Plate Tectonic Revolution (1966-1970). However, it is interesting that Alfred Wegener published in his last book a graphic display of a 'poll' he took on the timing of various ocean basin openings. We are, in a sense, taking that page out of his



Peter R. Vogt emigrated to the U.S. from Hamburg, Germany, a the age of 8. After receiving a B.S. at Caltech and a Ph.D. at the University of Wisconsin, he went to work as a research geophysicist at the U.S. Naval Oceanographic Office in Washington, D.C. For 5 years he was a member of the GOFAR project, but when the corp by years ne was a member of the GOCAN project, but when the oceanographic office was moved to Mississippi in 1975, Vogt switched to the Acoustics Division, Naval Research Laboratory, where he is presently employed. Professional interests include marine geology, plate tectonics, magnetic anomalies, and hot spots. Mass extinctions have always fascinated him, for the response of the blackbard of anytomorals should be a testing the falling to the content of the cont the biosphere to environmental changes must be telling us somethe prosperer to environmental changes must be telling as some-thing about the geophysical processes behind those changes. At home in southern Maryland, Vogt is a disciple of Eueli Gibbons and enjoys creating with natural materials, e.g. wood carving.



John C. Holden is a consulting geologist and freelance geoartist. He alternately visits the Late Cretaceous, where he studies dinosaur extinctions, and the Futurozolo, where he is writing a monograph on the decline and extinction of *Homo saplens*. The remaining time finds him directing the activities of the international Stop Continental Drift Society and editing the much dreaded ISCOS Commental Unit Society and sound instituted desired iSCDS

Newsletter, in the past, Holden has been reported present at various research facilities including the USC&GS, ESSA, and NOAA, and several universities. His function at these places remains a mystery. He should not be confused with his twin brother (with also the same name) who has published liberally in the plate tectoric and continental drift literature. Holden is best known for supplying and continental drift ineralities, readen is been known for supplying the scientific names to animals that do not exist, including the Loch Ness monster (Plesiophonus harmonicus), Biglioot (Sasquantinopus megapeditatus) and the Abominable Snowman (Detestapetheous hornorix), interested parties may write for a bibliography.

Questionnaire

Please respond to the statements below by giving the number of the one response that best describes your opin-

- Could very well be true.
- Possible but not probable.
- 3. Extremely unlikely but not impossible.
- 4. Impossible—violates present data.
- 5. No opinion-not familiar with hypothosis.

Statements

was caused by

The end-Cretaceous extinctions occurred because

- World climate warmed at the end of the Cretaceous.
- 2. World climate cooled at the end of the Cretaceous. 2a. Assuming warming or cooling was responsible, it
- (i) variation in solar activity;
- (ii) interstellar/interplanetary gas or dust;
- (iii) variation in terrestrial volcanic activity, possibly of short duration;
- (lv) nearby supernova;
- (v) collision with asteroid; fine debris discharged into upper almosphere;
- (vi) collision with comet: (vii) variation in plate tectonic activity, e.g., drop in
- spreading rate, drop in sea level; (viii) fresh or brackish water from Arctic Basin inundating world ocean.
- 3. Radiation increased. This was due to
- (a) nearby supernova. (b) solar explosion.
- (c) magnetic reversal and temporary destruction of Van Allen Belt.
- 4. Fine debris injected into atmosphere by asteroid impact blocked sunlight, decreased photosynthesis, and disrupted food chain.
- of diseases of one type or another.
- 6. of 'racial senility.'
- 7. of breakdown of oceanic circulation, resulting in a widespread anoxic event.
- 8. of widespread depletion of the oceanic plankton over a short time period, leading to collapse of marine trophic
- 9. of eustatic sea level fall, leading to restriction of shallow-water habitats. 10. of temporary depletion of critical trace elements such
- as Cu or Co.
- 11. of temporary toxic overabundances of trace metals. 12. of temporary O₂ deficiency caused by drop in marine
- phytoplankton. 13. of depletion of nutrients which was caused by low
- terrestrial relief, low runoff, and reduced land area. 14. of rise in carbonate compensation depth (CCD) to near sea level.
- 15. of successful competition by mammals (e.g., ealing dinosaur eggs); applies to terrestrial vertebrates.
- 16. The marine micro-fauna/flora extinctions occurred at a different time and therefore do not need to be explained by the same mechanism as the terrestrial (dinosaur) extinc-
- 17. The end-Cretaceous extinctions differ only in scale (magnitude) from those throughout most of the Cretaceous and Canozolo.
- 18. The end-Cretaceous extinctions represent a unique, or at least extremely rare, type of catastrophe.
- 19. The cause for the extinctions will be identified more or less certainly within the next few years. 20. The debate will continue because of lack of decisive
- evidence.
- 21. The iridium/osmium enrichment recently discovered at the K/T boundary is the decisive breakthrough and could do for massive extinctions what magnetic lineations did for plate teclonics.
- 22. The length of the extinction event was:
- (a) 10⁸ years or less,
- (b) 104 years or less,

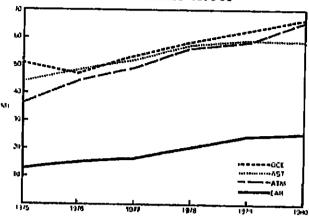
 $\mathcal{F}_{i} = \{ i, j \in \mathcal{F}_{i} \mid j \in \mathcal{F}_{i} \}$

- (c) much less than a 1000 years, perhaps only a few
- 23. The triggering event was truly instantaneous (e.g., an asteroid), although the extinctions occurred over a period of years.
- 24. Noah built more than one ark—the ark carrying the dinosaurs, etc., sank. 25. The end-Cretaceous extinctions were caused by in-
- tervention of extraterrestrial intelligence. 26. Other suggestions? Comments?

NSF Funding Trends in EPS

National Science Foundation trends in funding for research in universities in the Earth and Planelary Sciences (EPS) during the 5-year period 1975-1980 show gradual increases (see figure). The trend for ocean sciences has taken a mostly continuous increase that will continue if the Ocean Margin Drilling Program is supported in fiscal year 1983 as proposed. Support of the program has been in Jeopardy in Congress during the past months, but right now the prospects for continued support of the project appear to be favorable.

FUNDING IN AAEO 1975-80



The atmospheric sciences have had increasing stepwise support that could make it the largest program in the EPS portion within a year. The ocean sciences could also take the lead.

Astronomical sciences have what appears to be a levelling off in funding, but at a substantial base. Astronomy will be getting a boost in one sector—space telescope—during the present decade, with NASA funding.

The Earth Sciences Program proper (EAR) is significantly smaller than any of the other programs. Included in EAR are geology, geophysics, and geochemistry. The trend is levelling off; its extension cannot be predicted now. Possibly, it will increase again by fiscal year 1984. [Source: NSF)—*PMB* &

Dying Pacific Hot Spot

A team of scientists at the Hawali Institute of Geophysics report that they have evidence for a new hot spot in the Pacific Ocean. Their discovery was described by Barbara H. Keating at AGU's Spring Meeting in Baltimore late last month. The predicted hot spot, located in the Caroline Islands, halfway between Hawaii and Japan, is the first to show evidence of waning. Keating said.

Hot spots are sources of hot rock that may come from the earth's mantle, explained Keating, assistant professor of marine geology and paleomagnetics at the University of Hawaii. The hot rock melts through oceanic crust and forms a chain of volcanic islands and submarine volcanos. These volcanics show a strict age progression from oldest to

In the Caroline chain, three major islands--Truk, Ponape, and Kusaie follow the age progression, Keating's learn found. The scientists determined with radiometric dating that Truk is 12 to 14 million years old, Ponape is 8 million years old, and Kusale is 4 million years old. However, the islands are unusual in that the volume of Truk is twice that of Kusale. The Hawaiian Emperor Seamount Chain, parallel to the Carolines and also formed by a hot spot, shows the opposite pattern: The youngest islands have greater volumes than the older ones.

Geochemical studies show that the Caroline Islands have the identical source but that the magma that formed the islands changed with time. All of this evidence points to a hot spot that may have been dying during the formation of the Carolines, Keating said. She predicts that the hot spot is tocated at 4.8 N, 165.7 E.

Corroborative evidence comes from seismic work, local legend, and bathymetric charts, Kealing noted. Dan Walker at the University of Hawaii found evidence of seismic activinear Ponape. Also, according to a book published in 1899, Ponape warriors set their sails toward the southeast but hurriedly retreated when they saw fire in the sea. Keating believes that the 'fire' actually was an erupting volcano near the predicted hot spot.

Bathymetric charts show that a seamount, evidence of an old volcano, rises from the bottom of the sea north of the predicted hot spot location. Keating says she hopes to confirm the seamount's presence with ocean bottom seismometers this fall.

When Keating used paleomagnetic data to predict the position of the hot spot, the results varied about 2° from her predictions made on the basis of bathymetric and seismic

Shuttle Upper Stage for Galileo

NASA has awarded four letter contracts totaling \$7,483,000 for design of a modified Centaur launch vehicle and related components for use as an upper stage with the space shuttle. The modified Centaur will be an adaptation of the vehicle that has flown as an upper stage for both the

Atlas and Titan boosiers over the past 15 years, All of the contracts are in support of the Gailleo mission to Jupiter scheduled for launch in 1985 and the International Solar Polar Mission in 1986.

Under a \$3,412,000 contract with General Dynamics Corp., Convair Division, San Diego, Calif., a modified Centaur vehicle will be designed.

A contract for \$1,593,000 was signed with Honeywell, inc., Avionics Division, St. Petersburg, Fla., for the design and development of the inertial measurement group, a part of the self-contained automatic navigation and guidance

A \$1,545,000 contract with Teledyne Industries, Inc., Northridge, Calif., was awarded for the onboard computer and remote multiplexer unit. The remote multiplexer units comprise the basic airborne data information system to supply inflight data.

All work under these contracts is scheduled to begin about June 1 and continue through Sept. 30, 1981. Under a \$933,000 contract with United Technologies Corp., Pratt & Whitney Aircraft Group, West Palm Beach,

Fig., RL10A-3-3A rocket engines will be built. Primary thrust for the Centaur is provided by two of these engines. which develop 33,000 pounds of total thrust. Work will begin on Aug. 1.

The Centaur program is managed by NASA's Lewis Research Center in Cleveland for the Office of Space Transportation Systems' Upper Stage Division, NASA Headquarters, Washington, D.C. [Source: NASA]—PMB 63

Puzzling Over Saturn's Internal Heat

One of the most interesting things to come out of the Voyager experiments, according to Voyager scientist Andrew Ingersoll of Caltech, is the measurement of Saturn's nternal heat. Before the Voyager 1 experiments, Saturn didn't fit with science's view of the solar system, he noted.

Early ground-based observations and Ploneer spacecraft observations indicated that Saturn had too much internal heat,' said ingersoil. 'One outrageous possibility is that Saturn is only 2 billion years old and therefore has not lost the expected amount of heat. Such a possibility, if true, he continued, would shatter our understanding of solar system formation.

Infrared detectors aboard Voyager 1 showed that about one half of the helium is missing from Saturn's atmosphere. 'The missing helium, if it had settled out toward the center of Saturn, could just account for the additional energy now being radiated, Ingersoll told fellow scientists at AGU's spring meeting. Helium raindrops then would tend to form about halfway down towards the center. The large internal heat previously detected includes that released by the helium rain, ingersoil concluded.---BTR %

Saturn's Rings: Debris From Satellites

Saturn's rings may be the remains of at least three satellites smashed by a comet about 4 billion years ago. That's the latest word from the Voyager scientists at AGU's Spring

The rings are fragments of preexisting satellites, explained Eugene M. Shoemaker of the U.S. Geological Survey in Flagstaff, Ariz. Breakup of the satellites could have been caused by a comet and by the satellite collisions. Satellite fragments then smeared out to form the complex ring system photographed by Voyager 1 last November, he

Shoemaker's theory reverses a previous assertion that the rings are the leftovers of cosmic matter from which the satellites were formed.

Mirnas, easily identified by the impact crater covering one-fourth of its diameter, is a still-life of cometary impacts, Shoemaker said. The impact that caused the crater was just below the threshold of breaking apart the satellite, he sald. Mimas remained intact, though, a 4-billion-year-old

The two coorbiting satellites—Saturn's tenth and eleventh—also substantlate the fragmental debris theory. Shoemaker said these irregularly shaped moons were once pieces of a larger satellite. Similarly, the F ring is the residue of satellites like moons 10 and 11, he added.—BTR 38

New Center for Air-Sea Studies

Prompted by the increasing recognition of links between the oceans and the atmosphere, the University of Rhode Island recently established a Center for Atmospheric Chemistry Studies. Located within the Graduate School of Oceanography, the center researchea air/sea interactions and the sources, transport, and reactions of gases and particles in the atmosphere on local, regional, and global levels. Oceanographer Robert A. Duce directs the center.

Almospheric studies underway at the university, including SEAREX (Sea-Air Exchange) and investigations of Arctic air pollution, will conlinue under the auspices of the center.

The Search for Non-Newtonian @

Geophysicist Frank D. Stacey and his colleagues from the University of Queensland, Brisbane, Australia, are attempting to lest the laws of gravity. Physics and physical science laboratories have made numerous attempts in recant years to look for deviations in G, the gravitational constant, for the purpose of supporting non-Newtonian theories. Physicists would like to include G, and gravity fields (and waves), in a unlited theory, but the results of the labo-

Forum

Building a Base

AGU has benefited the academic geophysical community since its inception. It has become a major medium of scientific communication through its excellent journals and meetings. It represents us at International neetings and has assisted those who have traveled to such meetings. Also, in these times

AGU when academic science, particularly basic science, is under some pressure, AGU can

serve an important role in presenting the case for basic research in public forums. For all these reasons AGU deserves the support of the academic community, but why should we contribute to AGU-GIFT? Do we not already pay in my own case, the answer to the questions posed above arises from my own recent experience: 4 years ago!

was appointed to a faculty position and began building a esearch program. In seeking to accomplish this, the desirability of a permanent 'base' of money and resources has become very evident to me. It is extremely difficult, I think, to build and maintain a long-term program of any kind if the only resources available are short-term resources, such as annual dues. Some form of reserve is necessary to handle such matters as coping with unexpected fluctuations in income and meeting special needs. A base of capital equipment, facilities, and space is necessary to ensure the physical continuity of the operation. This is what AGU-GIFT can provide, and I commend it to you as worthy of your sup-

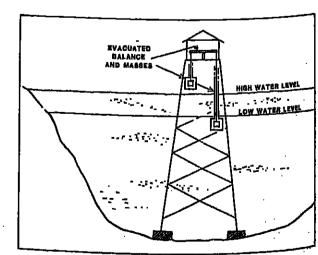
> Anton M. Dainty Georgia Institute of Technology

Note from AGU-GIFT Steering Committee: Professor Dainty's check was the first to be received at Headquarters last December

ratory experiments with mass attraction have been more or less noncommital. Now for the first time in many decades the problem is back in the hands of geophysicists—where it

Frank Stacey, who has been known for his theoretical analysis of the thermal properties of the earth's mantle and core, has been formulating a series of unique experiments that he hopes will provide a good test for the inverse square law. Under development are two separate projects to determine the gravitational attraction of a layer of water: one in the ocean, one in a lake. (Stacey, F. D., Possibility of a geophysical determination of the Newtonian gravitational constant, Geophys. Res. Lett., 5, 377, 1978; Stacey, F. D., and G. J. Tuck, Non-Newtonian gravity: Geophysical evidence, Nature, in press, 1981.)

The ocean measurement will be done jointly with marine geophysicists of Texas A&M. The Intention, subject to NSF funding, is to employ the submersible vehicle Aivin, and at stationary positions, measure vertical gravity profiles to depths of 3500 km. They plan the first measurements on the Sigsbee Abyssal Plain in the Gulf of Mexico because of lis relatively featureless topography. Beneath the 3500-km layer of seawater, *Aivin* will be stabilized, and a stable plates. form will be used for the grainmeter.



Schematic view of the Splityard Creek gravity experiment. A ba ance compares the weights of masses suspended in evacu tubes at different depths in a lake as the lake level is changed. balance is supported by an observing platform on an electricity (i) ion that minimizes corrections for the absence of water in the Wiume occupied by the material of the pylon. [Per references clied in

The second experiment will be done in a hydroelectric pumped-storage lake, where the level will change 10 m once or twice a day (see figure). The storage lake is local ed on Splityard Creek, a minor tributary of the Brisbane River, just upstream from the nearly completed Wisienhoe Dam. A very accurate balance will weigh 10-kg masses that will be suspended in evacuated tubes at different level of the lake. A Capacitance detector will be sensitive enough to measure it part in 10° of ambient gravity constant and the property of 3 parts in 10° in attempting to limit evidence for a non-Newtonian gravity.

lational effect, the two experiments are considered complementary. Both experiments constitute the largest scale sysem for measurements of this accuracy ever attempted. The masses are large (the layers of water), the systems simple, and the precision is comparable to that of a conrolled laboratory experiment. Aside from the search for non-Newtonian effects, the results should provide a new accurate value of G.—PMB 88

Equal Opportunities Committee

To encourage women, minorities, and other groups curently underrepresented in science and engineering, the National Science Foundation created, at the request of Congress, the Committee on Equal Opportunities in Sciance and Technology. Appointments to that committee were recently announced.

Carol Jo Crannell, an astrophysicist at NASA's Goddard Space Flight Center, is one of 16 scientists on the committee. Cora B. Marrett, professor of sociology at the Universivol Wisconsin, will chair the committee.

Qeophysicists

Vinod P. Bhatnagar was recently appointed senior staff hysicist in the Department of the Environment of Monited Ud. in Concord, Ontario. Formerly of the University of Western Ontario's physics department, Bhatnagar is also a consultant to the Centre for Research in Experimental Space Science at York University in Downsview, Ontario.

Gordon Ealon will become the dean of geosciences at Texas A&M University on September 1. He succeeds Earl Cook, who has held the post for 10 years. Eaton, a former associate chief geologist with the U.S. Geological Survey's geologic division, is known for his research in the volcanic history of Yellowstone National Park and for tectonic studles on the western United States.

The following have been elected Fellows by the American Academy of Arts and Sciences: Wallace Gary Ernst, UCLA; Robert L. Fleischer, General Electric, Schenectady, N.Y.; John Imbrie, Brown University; Paul Beattle Mac-Cready, Jr., Aero Vironment, Inc., Pasadena, Callf.; Joseph Victor Smith, University of Chicago; Hugh P. Taylor, Jr., California Institute of Technology; and M. Gordon Wolman, Johns Hopkins University.

New Publications

IMS in Antarctica

T. Hirasawa (Ed.), Mem. Nat. Inst. Polar Res. Spec. Issue 16, National Institute of Polar Research, Tokyo, v + 144 pp.,

Reviewed by T. J. Rosenberg

The first major symposium on results of the international Magnetosphere Study (IMS) was held at La Trobe University, Bundoora, Victoria, Australia, from November 27 to December 1, 1979. The present volume IMS in Antarctica is a collection of 11 of 13 papers on Antarctic research that were presented at this symposium. It is dedicated to Takesi Nagata of the National Institute of Polar Research, Tokyo, for his continuous efforts to develop geophysical research in Antarctica since the IGY.

The post-iMS data analysis phase is still in an early stage. Anterctic research no doubt will be shown to have contributed significantly to realizing many of the objectives of the IMS. But, it seems to me premature to have published a book on this theme now. Nevertheless, the material included is informative and is illustrative of the significant contributions that Antarctic investigations can make in geophysical research. The book serves principally to summarize the Japanese work (6 of 11 papers). Other papers are by Russian (1), New Zealand (1), British (2), and American (1) authors

Nagata et al., in five papers, summarize auroral-zone measurements from Syowa Station. Information is presented on precipitating electrons, the spectra of VLF and HF plasma waves, and vertical profiles of electron density and DC electric fields. The spatial extent of VLF emissions in magnetic latitude and local time is determined from satellite data received at Syowa. Conjugate relationships for various types of ULF and VLF waves are examined and a classification scheme proposed. A new direction finding technique for auroral hiss emissions is described. Results show that hiss is associated with localized active regions of bright aurora. Kleimenova and Golikov, using simultaneous data from Syowa and Molodezhnaya stations, contrast the spatial extent of continuous and impulsive hiss. Another paper on Syowa observations, by Hirasawa, classifies auroral luminosity pulsations with frequencies of 0.05-40 Hz according to spectral characteristics.

The remaining papers in this volume discuss measurements obtained at subauroral fallitudes. Unwin and Cummack discuss the lonospheric signature ('drift spikes') of large poleward-directed electric fields with a VHF doppler auroral radar operated from the south of New Zealand. Lester and Smith present results from Halley Bay of a whistler study of the bulge region of the plasmapause showing the anomalous occurrence of rapid inward (cross-L) drifts of whistler ducts. Matthews and Yearby compare the properties of magnetospheric VLF line radiation observed at Halley Bay with those of power line harmonic radiation as observed at Siple Station. Last, the paper by Bell et al. shows that signals from the Siple Station VLF transmitter. propagating in the nonducted mode, are observed continuously over large regions of the plasmasphere.

in sum, these contributions only touch on the variety and scope of the research activities carried out in Antarctica during the IMS. Much of the material has already been published in journals or is on the verge of publication.

T. J. Rosenberg is with the Institute for Physical Science and Technology, University of Maryland, College Park,

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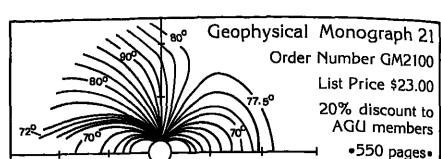
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Meetings

Delegates to IAGA and IAMAP Assemblies

U.S. scientists planning to attend the Fourth Scientific Assembly of the International Association of Geomagnetism and Aeronomy to be held August 3 to 15, 1981, in Edinburgh. Scotland, and the Third Scientific Assembly of the International Association of Meteorological and Atmospheric Physics to be held August 17 to 22, 1981, in Hamburg, Germany, should notify A. F. Spilhaus, Jr., secretary of the U.S. National Committee of IUGG, at the American Geophysical Union, 2000 Florida Avenue, N.W., Washington, egates from the United States to these assemblies. o

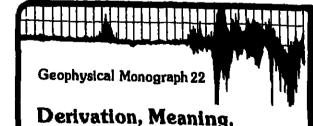
Water and Energy Conference

A two-part conference entitled 'Water and Energy: Technical and Policy Issues' will be held late in the spring of 1982. The Easiern Conference will be held in Pilisburgh. Pa., on May 23-26, 1982; the Western Conference will be In Fort Collins, Colo., on June 27-30, 1982.

Primary objective of the conference is to exchange information and stimulate discussion among technical speciallats, public interest groups, and those who have legislative or public policy influence in energy development and assoclated water resource Issues. Among the topics to be included on the agenda are water requirements and availability for energy development; ground and surface water quality; hydrologic impacts; hydropower; and water resource aliocations and their legal, economic, and political consider-

Potential contributors to the Eastern Conference should send abstracts (200 to 400 words) by September 1 to Fritz Kilpatrick, U.S. Geological Survey, National Center, Mail Stop 414, Resion, VA 22092. Abstracts of the same length for the Western conference are also due September 1; send them to Don Matchett, Stone & Webster Engineering Corp., P.O. Box 5406, Denver, CO 80217.

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To facilitate multidisciplinary communications, this meeting will immediately follow the annual CalCOFI meeting. For additional information, contact R. Michael Laurs, EPOC Secretary, Southwest Fisherles Center, NMFS. La Jolla, CA. Christopher N. K. Mooers is chairman of EPOC.

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ASSEMBLY TRAVEL

Third Scientific Assembly, International Association of Meteorology and Atmospheric Physics, August 17–28, 1981, Hamburg, Germany

Fourth Scientific Assembly, International Association of Geomagnetism and Aeronomy, August 3-15, 1981, Edinburgh, Scotland

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Haing synchrotron radiation as a continuum background, the cross seatthes of So, in the 180-228
and 299-340 am region and of CS; in the 318-350 ms
region have been assaured with a bendwidth of
0,06 ms. It has been confirmed that the reported
band positions of SO; in the 170-315 ms region by
Varnack at al. (J. Chem. Phys. 49, 1127, 1964)
should all be shifted by ~ 0.3 ms toward shorter
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Study of the rocketsands temperature
and wind date for the tropical station Thumbs (8.50%, 76.90) suggestion Thumbs (8.50%, 76.90) suggestion Thumbs (8.50%, 76.90) suggestion Thumbs (8.50%, 76.90) suggested (i) mesociation between the soudresume of high-level mermings and mongoon activity in the Indian region
and (ii) relationship between the stretespharic quad manapharic structure and
the monsoon reinfall. In order to
test the validity of the above results
for other tropical stations and to
duciment the differences in the etaduciment the differences in the etatospheric and manapharic conditions
during the years of contrasting moncom activity, the date for Accasion
Island (8.00%, 14.40%) and Kwalelain
[8.70%, 147, 700] for foke winter geacons (.Becember 1971, 1974-1975 and 19751971, 1971-1972, 1974-1975 and 19751971, 1971-1972, 1974-1975 and 1975)
to September 1971, 1974-1975 and 1975)
ware investigated. During 1975 and
uring 1975 it was vary week and
during 1975 it was vary week and
during 1975 it was vary week and
ware noticed to occur in the areasoin
pheric/hesospheric region at Accasion
island and Kimilalain during winter, and
Island and Kimilalain during winter, and
island and Kimilalain during the morthern
stations was mariade to higher levels
wareings of in-290c within saven days
warence as account the wary the hearthern
wareings of the fartings at both the
southern hemisphere
the northern hemisphere
the northern hemisphere
the northern hemisphere
the northern hemisphere

ings and thickness of warming layers were less at both the stations in 1972 than in 1975. The zonal wind was strong easterly at the lower stratosphere and weak assterly at the upper stratosphere in 1972. An opposite trand in the zonal wind was noticed during 1975. A quesi-biennial oscillation in the wind in the stratosphate was observed at Ascension Island and Kwajalsin which was in agreement with the results obtained from the eacler study for Thumbs. (Tropical stratosphere, temperatures and winds, summer sensoon, quesi-biennial structure).

Electromagnetics

cture). J. Geoglys. Res., Grand, Paper 160824

O703 Antennas
PERINSULA IMPEDANCE MEASUREMENTS IN THE
MARLBOROUGH SOUNDS, NEV ZFALAND
R. Barr (Geophysical Observatory, PO Box
2111, Christchurch, Nev Zesland.)
Heasurements have been sade of the input impedence, at YLF, of a deries of
transmission lines commeted series a
peninsula in the Martborough Sounds, New
Zesland. No resonances in the imput
teredence have been found which caunot be Zealand. No resonances in the imput impedence have been found which caunot be explained in terms of basic sarth return transmission line theory, the surrounding sea serving only to provide low impatance line terminations.

In contrast to the assertions of Morgan (1980), the phase velocity of propagation along the sarth-return transmission lines has been found to decrease markedly as the cables are lowered to the earth's

arrace.

It is concluded that the "peninsule" and "Leisud" recommnes observed near 10 kHs by Gould (1961) and Morgan (1979) were simply only recommended. the phase velocity sieng the subles buying beam reduced by their proximity to the ground.

(Paningula, island, YLP, addenne) Rat. Bat., Paper 180918

Exploration Geophysics

0920 Magnetic and electrical mathods EXPERIMENTAL USES OF SHORT PULSE RAPAR IN COM.

granteral (2000 or another roles asserted plyinion, STANS

J. B. Coop (Concor, Inc., Niming Kansarch plyinion, Box 1267, Posca City, OK 74601) J. C. Forler, and C. J. Schafers

We discuss ber's astrict of intences and refinetion renies obtainable in cost with currently available short-pulse rader, the various field tests
were conducted in 1977 and 1978.

Three different types of racts were presented.
The first paries of reuts excelled the penetration
distances, valualty of propagation, and attacastion
varues frequency in a large cost pillar. The valuaity of propagation was approximately half that in

the sir. The tests shows that it was possible to transmit electromagnetic (DM) energy in the range of 20 to 300 MHz through 10 ft of coal. The tests slop showed the definite polarization effects that had previously been measured in coal. The second series of tests was designed to show the mediana reflection distances for radar with a center fraquency of 100 MHz. Using common-depth-point (CDP) reflection ecchniques, a tenfold CDP line obtained reflections for distances greater than 30 ft. The final series of tests was conducted to locate a six-inch borchole within a coal pillar. The radar system located the hole quickly and massly swan though it was 20 ft into the pillar.

The tests have shown that it is possible to use

O220 Magnetic and electrical methods
THE TELLURIC-MAGNETOTELLURIC MITHOD IN TWO-AND
THEMS-DIMENSIONAL ENVIRONMENTS
John A. Stodt (University of Utah Rasearch Institute,
Earth Science Laboratory, 420 Chipets Vay, Suite
120, Sait Lake City, UT 84108) Gerald W. Rohamm
and Sam G. Ting
The sesumption of spatial uniformity of the horimontal sagnatic felaid, which is an implicit assumption sade in straightforward applicacions of the
tailuric-magnetatelluric (T-MT) method, is not always valid asar conductivity inhomogeneities. For
a two-dimensional (2-D) case, the grassware elsetric mode horizonal magnetic field may vary wore
than a feator of three. The spatial variation of

tric mode horizontal magnetic field may vary more
than a factor of three. The spatial variation of
the borizontal magnetic field in not as great over
three-dimensional (3-D) inhomogeneties, but it may
setil contribute afgnificantly to impedance magnitude and phase over shallow inhomogeneties at
higher frequencies.

Spatial variation of the burisontal magnetic
field can cause T-HT impedances to differ elgalificantly from magnetocalized (HT) impedances. Consequently, HT modeling of T-HT field data could result in a misleading interpretation of conductivity attuders. To would arrondoms interpretation,
numerical modeling programs should calculate actual
T-HT data. Resolution of a conductivity structure
which produces eignificant spatial variation of the
magnetic field is less with T-HT data than with on
outsel number of MT data. Novever, the increased numbet of data obtained from a T-HT survey bay offeat
this shortcowing if the data are properly interpreted. preted. Geophysics, Vol. 46, No. 4

Of 20 Magnetic and electrical methods
THE IMPLEMENT OF CHRURES THOUSED IN THE MET BOCK
OR SIZORGHAGHSTIC RESPONSE OF A STREETED DIRECTLY
REPARTS A LOSS
Alarander A-Emission (Department of Geophysics,
Colorade School of Hipse, Colorade, Co. 60404)
A variety of Cime-downin and fraquency-downin
electromagnetic (20) methods has come into use in
mineral a empharation for detection of conductive
ore bodies. Secause the response of these various
my stems differ methods from one amother, the question arises as to which is the most effective for
use in discovering a burked, conductive ere body.
The question can be posed as follows that type of
exploration system provides the best signal-tomosts (S/H) totio, when signal is defined as the
secondous DV Field capted by the presence of a target body and noise is defined as 2H temponase from
the surrounding medium Analytic solution of the
problem in tedious and has not yet been reported
in the literature, I describe some results for a

OBJAINING TUBER-THENSIONAL VALUETY EMPORATION DIRECTLY FROM REPLECTION SPISMIC DATA: AN INVISES DIRECTLY FROM REPLECTION SPISMIC DATA: AN INVISES SCATERING CONDUCTION OF THE PROPERTY PRODUCTION A. N. Vegledin (Citien Service Co., Finergy Pennurons Group, P. D. Co. 1998, Tules, 60: 741021 W. F. Royse and J. F. Anderson

Me present a formalionifor obtaining the subsurface velocity configuration directly from relication selected data. Our approach is to apply the remails obtained fire inverse problems in quantum scattering theory to the suffection selection spinion scattering the selection, and Pageov (1975) for inverse quantum scattering and Pageov (1975) for inverse quantum scattering and Pageov (1975) for inverse quantum scattering and Pageov (1975) for the send-dimensional (1-D) identification of the country was equation to the problem of identifying the velocity in the three-dimensional (1-D) accounts was equation from houndary value consumerations. No a priori in-wiedge of the subsurface velocity is appeared and all refraction, diffraction, and cultiple selication phracterns are taken into

0910 Setable methods A mathod for Captulating Symmetric Setsonorand Displaying corporation on Oilo Computer applications . C. Cacley (Poswerly Archa Production Posesich autor, Tulmag presently Union Oil Co. of Canada 09:10 Salamic methods MAXIMON ENTROPY SPECTRAL DECOMPOSITION OF A SEIS-MOGRAM THTO TITS KINDROW ENTROPY COMPONENT PLUS

See 6710 Computer applications
See 6710 Computer applications
Seen Traite1 (Amoco Production Co., P. O. Box 591,
Tules, OX 74162) Inders A. Robinson
Ma consider an M-layered elastic nedium which is spectrum. If we add white noise to the seismogram, the power spectrum becomes a maximum entropy spectrum. The maximum entropy spectrum can thus be decorposed into the sum of a minimum entropy spectrum plus white noise; this spectral decorposition is due to Piesrenko (1971). If the insulated medium is excited at time t = 0, the resulting synthatic selectures of efforts rather remarkably from the selectures obtained for accitation in the resons page. Complysica, Vol. 46, Ed. 8.

Geomagnetism and Aeronomy Volume 20, Number 2

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Maksimov V. P., Senatorov V. N. About penetration of irregularities of solar wind inside the magnetosphere . Samokhin M. V. Quazi one-dimensional model of the magnetospheric boundary in disturbed conditions

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Drobdzhev V. I., Pelentizin G. M., Khachikyan V. S., Sharadzo Z. S., Yako-VLF radiations Shagaev M. V. About the verification of Weinstock conclusions for hydroxide emission of night-sky luminiscence Valchuck T. E., Fel'dshtein Ya. L., Livschitz M. A. Forceast of geomagnetic activi-Valchuck T. E., Fel'dahtein Ya. I., Livschitz M. A. Forceast of geomagnetic activity in a solar cycle 21

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Chronicle

Geochemistry

1410 Chemistry of the alcomphese INFLICATIONS OF NATURAL SOURCES FOR THE LATI-TUDISAL GRADIENTS OF NO₂ IN THE UNFOLLUTED

TIDIDAL GRADIENTS OF NOy IN THE ONFOLLATED TAPPOSPHERE
SALEM Hassead (Laboratory for Planatary Atmospheres Research, State University of New York, Stony Brook, New York 1174) Olga G. Paidouseis and Hichard W. Stewart
We investigate the Intitudinal variations of the sources of tropospheric add nitrogen (Noy) due to lightning discharges and atratosphere-troposphere anchange. By slee considering the latitudinal variation of the cameal rate in reinous we calculate the Noy discributions in the troposphere using a one-diseaselonal model. We then discuss the Supilcations of the charge-teristic latitudinal gradients of ROy due to these two sources is view of the GAMETAG measurements in the Free troposphere.

14to Chemistry of the atmosphere ATMOSPHERIC METHANE (CH₁): TRENDS AND SEASONAL CY-

ATMOSPHERIC METHANE (CH₀): TRENDS AND SEASONAL CTCLES
R. A. Rassussen (Oregon Graduate Center, 19600 M.W.
Maiker 2d., Basverton, OR 97000) SM. A. R. Khaill.
Based on twenty-two months of almost continuous,
autosated, GC/FID measurements of atmospheric CL,
at Caps Hearns (45°M), we show that the conquentstion of CR, is increasing at about 2% per yr (20.5%
yr-1). The data also revealed atable measonal cyelse with peak concentrations in October and minimus concentrations in July. The asgnitude of the
measonal variations during these months is about
120 gpbw from the average (~1.2%). If the current
trend continues, the insteased CR, concentration
may result in s 0.2%—0.4% average increase in
earth's aurface temperature over the next 40 years
or so these on calculations of Mang at al., 1976).
The coupling of CR, to tropospheric and stratospheric theatest processes in discussed.
J. Goophys. Ras., Green, Faper 100154 i, Geophys. Ras., Green, Paper 100854

1440 Grochemistry of the solid earth HYBRID GRANODIORITES INTRUDING THE ACCRETIONARY PRISH, KODLAK, SHUMAGIH, AND SANAK (SLANDS, SOUTS-PRST ALASKA Malcolm IIII (14-HD Earth Sciences, Morthesstern University, Boston, NA 02115), Julie Morris, and

Joseph Wholan A serrow belt of consiste-granodiorice-granite piugens and sendithe intruse the actrainosary priss in southwestern Aleska about 60 m.y. ago, etsuitaneously with plutonism over 100 km north along the main are size. The presence of matassing the main are size. The presence of matassidisentary menoliths, hymnite, and garner within the intrusions supposed on the Kodisk, Shumagin, and Sanak Islande satablishes the presence of a crusal component. 6'00 ranges from +10.9-+13.2'oc entressly high volume which require a crusal original for much of the oxygen in the intrusions. Opensystem alteration has disrupted whole-rock Rb-Sr aystematics in some samples. Riberal isochrons using unsitered minerals yield an ago of 58.7+1.2 m.y. and 87.86-7 0.705.34-10 for the Shumagin betholith, and an Egs of 62.7 +1.2 m.y. and 87.86-7 0.705.34-10 for the Sanak pluton. Comparison of the intropic data for the intrusions with those of sedisentary rocks in the Kodisk and Shumagin Fornations roquire that a low-6'01, low-8'97.8'57 component bu present within the intrusions as wall. Mining models combining \$757.8657 and \$7 contents of writous kinds of mafic magnes with partial moles of oxisesdicontary well-rocks suggest that three types of mafic magnes can satisfactorily duplicate the oxygen levtope signature of the intrusions: (1) s MORS-like magne, (2) a magnes derived by partial fusion of altered MORS, or (1) an are baselt. The MORS model provides a barter trace element match than the resulted MORS model does not. The strusions are praceded by a pulse of mafic to interesdiate volcantam neat or within the strutions are praceded by a pulse of mafic to interesdiate volcantam neat or within the strutions are praceded by a pulse of mafic to interesdiate volcantam neat or within the strutions, and may be related to activity of the meanly kuls-Faralion ridge sprovimately 00 m.y. ago. [geochemistry, granttic rocks, magnetic arc, Alaska)

Geomagnetism and Paleomagnetism

2520 Interactions between exterior sources and interior properties (asgnetotelluric effects) THE RELATIONSHIP REMIEN INTERFERATURE DISTRIBUTION AND THE REMIENSHIP REMIEN THE PRATURE DISTRIBUTION AND THE PRATURE OF A THE PRATURE OF A SURDICTING LITHISPERIC SLAB P.W. Jones (Department of Physics and the Institute of Earth and Planetary Physics, University of Alberts, Edmonton, Alberta, Canada TeG 231) L.J. Pascow, V. Ramanwasy and L.J. Sydors
A non-dimensional rumerical model is employed to investigate the perturbation of time-warying electromagnetic fields by a subducting lithosphatic slab. A simple thermal conduction model, a model with shear strain heating, and a model with shear strain heating and a model with shear strain heating and a model with shear strain heating a periods. Also, a continental/oceanic interface in included, the results indicate that the hot material shows the slab considerably affects the spatial behaviour of the electromagnetic field components at the surface. The sactious perturbation of the vertical magnetic component occurs over the point where subduction begins in the simple conduction case, but when shear strain heating is present the maximum perturbation in this component occurs on the continental side of subduction. The nature of the vertical magnetic field porturbation changes considerably when rising salt is present. Apparent resistivity profiles accoas the subduction zone are resistivity profiles across the subduction zone are substantially different for the three models. The calculated apparent resistivity is significantly reduced when partial moit is present. (Temperature , sm-induction, subduction, slab). J. Geophys. Res., Red., Faper 188896

Hydrology

HIO Evenion and Sadimentation
COPED WITH INCREMEN STREAM EXCHISE IN
URRAINZERS ARREST
By Vision Agreements
By V. Whipple, Jr. (Nivision of Vater Resources,
Bapt, of Environmental Protection, Trenton,
R. J. ORCZ) and J. Dilcouis
This paper discousses the increasing channal
degradation being emperismed in many urbanising
area streams. Increased filocoling caused by intensive land development is related to attent
area introduced bed load transport theory. Analysis of these relationships leads to conclusions
as to channal design orderia. Current design
criteria for culverts concealing mich streams
should be modified. (Stream stabilization,
culverts, channal arealon, urbanisation).

Inter Raccur, Res., Paper 198855

1130 Groundwater
RASS TRANSPORT J. MOLE OF HYDRAULIC COMDUCTIVITY
DATA IN PREDICTION
Lasia Smith (Dept. of Sectory and Smophysics,
University of Usah, Smit Late City, Utah S4112)
Frantin in Schwertz
Frantin in Schwertz
Spatial variations in hydrautic conductivity
play acritical role in controlling contaminant
transport in groundwater flow systems. A stoclassic analysis of mass transport is cerried out
to investigate various relationships between the

number of hydraulic conductivity measurements available to characterize that heterogeneity and the resulting uncertainty in transport predictions. Uncertainties arise both from the unknown spatial variation in hydraulic conductivity and in estimating the parameters of the probability distribution for hydraulic conductivity. The simulations are based on limited sampling of hydraulic conductivity values from a series of hypothetical field sites. Results are interpreted in light of the uncertainty in dearmining sepage velocities within the flow system. The simulations indicate that considerable hydraulic conductivity data may be necessary to chiain a reasonable degree of confidence in predictions of site behavior. For the sample grids considered, the hydraulic conductivity data do not go far towards raducing the uncertainty in the ground-water velocity. The data seem most effective in locally influencing the mean velocity and constraining the variability in the velocity at the measurement points. A complex dependence is observed between the uncertainty in the velocity field and the hydraulic conductivity masprements. Transport predictions are sensitive to the arrangement of the heterogenetics inferred from the data set. Results of this study suggest that given a moderate number of data points, the unknown patterns of spatial variation in hydraulic conductivity are as more important source of uncertainty than errors in estimating the mean and standard deviation of the hydraulic conductivity distribution. and standard vity distribution. Vacar Resour. Res., Paper 190921

3130 Groundwater
ON IDENTIFICATION AND VALIDATION OF SOME
GEOTHERMAL MODELS
L. Ju. Fradkin (Physics and Engineering
Laboratory, DSIR, P.B. Lower Rutt, New
Zealand) N.L. Soray and A. Rchabb
Various distributed and imped-parameter
codels of the Mairakoi geothermal reservoir,
New Zealand, are discussed within a unifying
mathematical framework. The need for proper
system identification is erphasized. The best
imped parameter model obtained by system

3130 Groundwater MASS TRANSPORT IN DUAL-PORGSITY MEDIA

Water Resour. Res., Paper 140404

MASS TRAMSPORT IN DUAL-POROSITY MEDIA
Robert Bibby (Acomic Energy Establishment,
Windrich, Dornet, UK)
In dual-porasty media, such as fissured
aquifers in which the rock matrix has a high
persity but low permeability, the transport
of contaminants is controlled by molecular
diffusion between mobile water in the disauter
and essentially static water in the matrix.
This transport process has been modelled by
incorporating an analytical solution for
diffusion from a constant concentration
boundary into a 2-dimensional mass transport
model. The model uses Galerkin's method of
weighted residuals and isoparametric finite
elements to solve the flow and transport
squations. The model has been successfully
applied to a large-scale pollution event,
using historical data for califoration. In
the absence of such data, identification of
model permeters, aspecially dispersivities,
is very difficult. This is because the
molecular diffusion between mobils and
static water as greatly retard the transport
of contaminants that field tests at the
appropriate scale are associally pre-empted(Groundwater, mass transport, numerical model,
deal porceity).

Macas Masour, Ras., Paper 190474

31.30 Groundwater SEASONAL REVERSALS OF GROUNDWATER FLOW ABOUND LAKES AND THE RELEVANCE TO STAGMATION POINTS AND LAKE BUDGETS

Mary P. Anderson (Dept. of Geology and Geophysics University of Misconsin, Madison, WI 53705) and James A. Muntar Several researchers have observed seasons! re-

Sayeral researchers have observed seasons reversals in the direction of groundwater flow around labes. If these reversals are prolonged and are accompanied by the formation of a stagnation point, they may have a significant effect on a lake's water and nutrient budgets. The formation of a stagnation of the labe budgets the formation of a stagnation of the lake basin and recharges the groundwater system over the rost of the lake basin is accomplished by the formation of a groundwater mound on the downgradient side of the lake. In this paper the seasonal formation of a groundwater mound on the downgradient side of the lake. In this paper the seasonal formation of a stagnation point at Baske Lake, Wisconsin, is investigated with the sid of two-disensional transient computer models applied in cross section and areally. The analysis demonstrates the potential for the seasonal formation of a stagnation point at a flow-through lake and provides some insight into the transient development of the stagnation point. Water Resour. Res., Paper 190615

N.30 Groundwater
CARRON-14 DATING OF GROUNDWATER IN CONFINED
AQUIFES DEPLICATIONS OF AQUITABL DIFFUSION
E. A. Sudicky and E. G. Frind, Copartment of
Earth Sciences, University of Waterloo,
Vaterloo, Ontario, NZL 301)
The influence of diffusive losses into finepraised aquitarie on the 14c age interpretation
of groundwater in long, thin confined aquifers is
examined. An assiptical model is developed by
compling two one-dimensional strady-atte diffuential equations, one representing advantivedisparsive transport in the aquifer and the other
representing diffusion into the equitards.
The results indicate that aquifer diffusion is
a machanism that can cause a significant reduction in 14G concentrations in a confined aquifer.
Groundwater velocities derived from 14G measurements that are unadjusted for diffusion would,
therefore, be underestimated. The arror that
concerns that the strady-state distribution of 14C as shown to be relatively insensitive
to the asgnitude of the diffusion coefficient. In contrast, the steady-state distribution of 14C as shown to be relatively insensitive
to the asgnitude of the longitudinal disparsivity
value of the upper range of values that have been
reported in the literature produced a regligible
difference in steady-state 14G concentration reppared to results obtained using small disparsivities.

An equation is presented which parmits the

parter to results obtained using season.

Itas.
An equation is presented which parmits the adjustment of 14G data to secount for diffusion, and parter is not providing the equifor-equitard system is not stratigraphically complex and heterosponeous. The stratigraphically complex and heterosponeous snalysis can be extended to include age dating snalysis can be extended to include age dating in factorial first different from that isotophes that have half-lives different from that isotophes that have half-lives different from that isotophes that have half-lives different from that is the strategies of 14C. The results of this study also apply to age dating in fractured porous media.

Nature Resour, Res., Paper 180548

3130 Groundwater PRECOMBOLIDATION STRESS OF ACRIFES STATES IN AREAS OF INDUCED LAND SUBSIDERIES t. b. Holler (U.S. Geological Survey), 345 Middlefield Road, Manlo Fark, California, phones 345 Middlefield Road, Menlo Fark, California, 34025)

Aquifer systems in the Hop-Floucho great, and irisons, the Houston-Claveston area, Temps, and irisons, the Houston-Claveston area, Temps, and the Tular-dison crea and Santa Clare Valley, and California, appear to have been overconsolidated California, appear to have been overconsolidated to 5;2 bare (16 to 5;3 mol water) before man to 5;2 bare (16 to 5;3 mol water) before man began to withdraw groundater from them relation between land submissions and maker-level decision in these areas submissions and maker-level decision was appeared to 1,000 t raiss. Although alow dreinage from equitaria may have contributed to this response, it is interprated here to be esumed primarily by starful overconsolidation of the scenarily spent to squifer system. The water-level dealing at which the ratio of subsidence to unit water-level dealing the scenario by which the preconsolidation stress essected the overburden stress on the aquifer system that existed before groundwater withdrawals began. (Subsidence, groundwater, preconsolidation). Paper 1960-05

SIMO Procipitation
Of MATHEMATICAL STRUCTURE OF RAINFALL REPRESENTATIMES PARTS 1, 11, AND INT
M bysairs and Wijsy K. Gupto (Dept. of Civil Engthewesty of Mississippi, University, MS 38677)
PART 1-A REVISM OF THE STOCHASTIC RAINFALL MODBLES
This is the First of a three part series on the
esthematical structure of rainfall models. Several
important etcampia as modeling crimifall are reimportant etcampia as coverview of the three part
series is given as preface to this part.

PART II-A REVIEW OF THE THEMBAY OF POINT PROCESSES
Fart II constitutes the second of three parts deroid to the mathematical structure of rainfall.
As espoiltory, yet current, treatment of those
festers of Point Process theory which are essemtial to descriptions of the hydrologic process is
developed. A general overview of the three-part
series is given in Part i.
PART III-SOME APPLICATIONS OF THE POINT PROCESS
PART III constitutes the final part of three
parts devoted to the mathematical structure of
rainfall. The objective is to illustrate the
scope of the tools developed in Part II in the mameastical description of rainfall and reinfalldriven processes. A general overview of the threepart processes. A general overview of the three-

N/O Precipitation
A EDISOCLAMETIC RECOMPTRUCTION OF ARMUAL
(PRIPERATION AMOUNTS IN TOWN STREET 1680
D. S. Davick and T. J. Blasing (Environmental
Tissees Division, Building 1505, Cal Ridge
Retional Laboratory, F. O. Box Y. Cak Ridge,

is 1930)
Tree-ring widths from white cak (<u>Quercus alba</u>)
to entral lows were found to be accurate indistre of total precipitation for a period beginzing near the and of the prior graving senson
at standing until the and of the growing senson at steading until the and or the growing seaso is the year of ring formation. Regression-based stimes of annual (August-July) precipitation for low were obtained for the 300-year period of tree-ring record (1680-1979). The correlatio coefficient between actual and estimated precipi-tatics values was 40.7% for the 60-year period title values was 40.70 for the ob-year period of data used to calculate the regression coefficients, and 40.72 for the preceding Ms years of integrated data. These results show that tree rings are reliable indicators of wet and dry period in lows, thereby providing a 300-year fears of precipitation variations for use by

No Lunoff and Strampflow.

HYDATIC SUSTRFACE STORMFLOW

Latth Brean (Department of Environmental Sciences

Calversity of Virginis, Charlottesville,

Viginia 22903)

This paper hulds on the analysis of Henderson

Li Scoling (1964) in comparing simplified models

of subserface stormflow for the case of a sloping

roll cantle in which the hydraulic conductivity

is contant throughout. It is shown that models

bied on a kinematic wave formulation may be good

distributions to those based on the extended

lydiscinstictors to those based predicting both vator

tible profiles and enburghace stormflow hydro
pigia. The reage of values of alope angle and itile profiles and subsurface stormflow hydro-pais. The range of values of alops angle and bjirelic conductivity for which the kinematic Granibation is walld is compared to data from fuld experiments where subsurface stormflow has bee shown to be an important component of the suppose to storm ratifall. It is concluded that the kinematic approximation may be useful for ties of practical interest. (Subsurface storm-fler, kinematic undel, hillslope hydrology). May Rasour, Fes., Paper 180788

HED VESTER QUALITY
TLYPHIOD DESIGN OF REGIONAL WASTEWATER SYSTEMS:
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1 Staplified method is proposed for analyzing
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IND TAMES QUALITY
I EXTIGISHET VE BRANCH AND BOUND METHOD FOR
MINICIA-SECURED VATER RESIDENCES PLANKING
PRAINED
I. ARABOYA (University of Louisville, Louisville,
Lexicuty 40382) M. Biley
I will to just the branch and abound algorithm is
propored for use in analyzing multiobjective
fluid-charge maken's flow problems which are
fluid-charge maken's flow problems which are
fluid camenty to water resources planning situdition. Also proposed is a multiobjective impred value sandysis which makes use of the
track-and-hound tree structure and allows the
comparison of the importance of facilities in the
tricut, as represented by individual area or rate
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disprise procedure of the method are described,
and the potential use fulness of the action is
fellowed to proposed a hypothetical example problem
fulled in a regional wasterator treatment and
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fulled in a regional

New general or miscellaneous OF THE EXPECTED DIAMETER OF RANDOM CHARMEL

J.V. Moon (Mathematics Department, University of Alberta, Edmonton, Alberta, Canada) The religitions length of river networks tends is he proportional to the area of the coursehading drainings basin raised to a power that farmings from about 0.6 for small busine to ther 0.5 for large hasims. Shreve calculated the espected disaster u(D) of random channel. straits with a sources for values of a up to 500 . On the hapin of this minorital data be tracked that it seems likely that the ratio of s(p)/lof E approaches it as u inclasses. lateflaitely. Our object here to to prove that this is indeed the case, stee Bascar, Res., Paper Boscose.

Meteorology

A STUDY OF THE EFFECTIVENESS OF THE CIX CATALYTIC OZONE LOSS NECHANISMS

D. Wesbbles (Lawrence Livermore Metional Leboratory, Livermore, California) J. Cheng The importance of catalytic mechanisms involving chlorine species for descroying acratospheric acoust is now well recognised. In this study, we detarwine that there are at least four catalytic cycles of varying importance for analyzing potential odd oxygen destruction from chlorine species in the stratosphere. The relative efficiency of these cycles varies algnificantly with sixtudes. Since individual helocarbons release chlorine across over a wide range of different elicudes in the stratosphere, its impact on stratospheric ozone must be due to the combined effect of each of these cycles. Indeed, changes in the wettest of these cycles. Ludeed, changes in the wettest of these cycles. Ludeed, changes in the wettest of these cycles. Ludeed, crange of luorganic chloring releases and to differences in relative catalytic cycle efficiencies.

J. Chophys. Res., Green, Esper 100853

3725 Convertion, turbulence, and diffusion LONG TRUE GREENVATIONS OF THE ARCTIC MESOSPHERE VITH THE MST BABAR AT POKER VIAT, ALASKA W.L. Ecitumd (Marianal Ocasaic and Atson. Admin., Environmental Rassavch Labe, Aaronosy Lab. Boulder. Colorade 50303) B.B. Baiskay In this report we summerise the results of 22 months of observations of Arctic mesosphere schoes with the 50 MR rader at Poker Fiet. Alaska. With the 50 WHz reday at Poker Flat, Alasks, Operation with a partially complete system began in February 1979 and has continued on a nearly continuous besid to the present time. The sitt tude range of the mesopheric schoes obtained during this period shows a pronounced seasonal variation. During summer months the mesopheric schoes are relatively continuous in the and oxtend from shout 80 to 100 km with an unexpected strong peak in signal-to-quies ratio at about 83 km. In contrast, in son-summer moths cashphoric dechoes are less intense and occur. apheric dehoes are less intense and occur at lover altitudes in the range from 35 to 85 km. These lover altitude non-numer echoes are ob-corved primarily during deprime hours when unor-

3735 Electrical phenomena
LAYERED LIGHTHING ACTIVITY
D. R. MacGorman, A. A. Few (Dept. of Space
Physics and Astronomy, Rice University, Mouston,
Texas 77001), T. L. Teer
The horizontal extent of lightning channels
reconstructed acoustically from several storms
is significantly larger than the vertical extent.
Furthermore, an examination of all the reconstructed lightning structure in each of three
storms, one in Arizona, one in Colorado, and one
in Florida, shows that the lightning activity
tands to occur in layers 2-3 km thick. In the
Arizona and Florida storms, there were two layers
of activity. Temperatures at the lower boundary
of the layers were near 4% and -18% in the
Arizona storm and -11% and -39% in the Florida
storm. In the Colorado storm, there was a single
layer having a lower boundary near the O'C isotherm. Our interpretation is that each of the
two layers in the Arizona and Florida storms is
associated with a corresponding charged region in
the dipole of the thundercloud charge distribution. We suggest that the single layer in the
Colorado storm was a result of the dipolar
regions being closer together in altitude. regions being Closer together in allitude. [Lightning, thunderstorm, atmospheric electricity, storms]. [Y. Sacphys]. Res., Green, Paper 100852

TYAC General circulation
STRATOSPHERIC-MESOSPHERIC MIDVINTER DISTURBANCES: A REVIEW OF OBSERVED CHARACTERISTICS
X.Lebizke (Institut für Meteorologie,
F.U. Berlin, Federal Republic Germany)
The midwinter temperature changes in
the mesosphers and attratosphere are
described using conventional and satellite data. It is shown that over the
Northern Hemisphere the so-called stratospheric midwinter variangs extend into
the upper mesosphere. The differences
between both hemispheres are pointed
out. The activity of the planatary-scale
waves during the last 16 northern vinters and the importance of the asplification of height wave i before the beginning of a wejor varing are discussed.
It is shown that during the northern
winters the structure of the quasi-stationary waves shows an irregular intersamual variability which can be commented
with the variability which can be commented
with the variability of the polar stratospheric temperatures, In contrast, the
southern stratospheric winters are
rather regular.
J. Georgys. Res., Gream, Reper 100652 rather regular. Green, Paper 100652

3755 Interaction of atmosphere with

S755 Interaction of atmosphere with electromagnetic waves on DETECTING SEFLECTIONS IN PRESENCE OF DETECTIONS TO DETECTING SEFLECTIONS IN PRESENCE OF SCATTERING FROM AMPLITUDE STATISTICS WITH APPLICATION TO D-EEGION PARTIAL REFILECTIONS
P. K. Rastogi and O. Holt (Auroral Observatory, P.O. Box 96S, Tromes, Norway)
In many radar experiments which use transmission or scattering of radio waves through a random medium, the received signal is modelled as a reflected sine wave of amplitude a in a scattered marrow-band Gaussian random process of variance 2 d. In this model the received signal amplitude has a Rice family of distribution obsratterized by a parameter a = A/G. It is shown that amplitude statistics cannot be used to discriminate weak reflections from scattering (< 0.0). Behaviour of mean, skewness and kurtomis of the normalized signal amplitude is examined for a constant and an intermittent reflected component. It is shown that intermittency has a strong effect on these.

these.

Applications to a D-region partialreflection experiment at Trooms are
briefly discussed. It is shown that, at
least in some simple cases, enhanced
reflections arise from the top and bottom
parts of turbulent layers.
Red. Sci., Paper 190860

Mineralogy, Petrology, and Crystal Chemistry

tory, Group GRC-7, NS 314, Los Aleson, was related a 7343, USA. Geochean problems that would benefit from large scale experiments include: .1) the determination of the physical properties of the many common recks that are chamically homograsous on the scale of 5-100 cm but not on a scale of 1-5 cm. 2) the study of the influence of reck tentures and composition and of the chemistry of the pore solution on atreas correlated reaching and 3) the study of themsels transport within are justed in temperature chemical potentials and appeals in temperature chemical potentials and atreas scale studies about his the development of predictive models.

A260 Paragenesis, pstrography, and pstrogenesia PETROLOGY AND OBSCANGASCOY OF METAMORPHOSED VOLCAMIC BOCKS AND A MIDDLE-CRETACROUS VOLCAMIC NECK IN THE EAST-CRETAL SIERRA NEWADA, CALIFORNÍA BORAID W. Elster (U.S. Geological Survey, Memlo Park, CA 9025, U.S.A.) and Samuel E. Swenzon Metamorphosed Mesowate volcamic rocks from the east-central Sierra Newada range in composition from hamalt to rayolite and have agen, hased on midola-rock Medical Family of Parageon (U.S. 16), 134, and 160 2.7. The major plutons of the batholith kn this area are of Trimasto (21% to 200 m.y.) and Cratageous (9% to 80 m.y.) ages. unitial Disputs of the area are in the range from 0.70%2 to 0.70%3 and are generally different from the values for the surrounding batholithic rocks (0.70%5 -0.7066).

welces for the surrounding betholithic rooks (0.7056-0.7066).

A sircular, somed ggasitio plutan, with an outerop area of 2.5 km², sisiser in appearance to s ring dike complex, was appearantly a conduit for some or possibly sil of the middle-freakmanus metamorphased wolcante rooks apposed about 5 km to the south in the western part of the Mitter Range. Samples from the metamorphased wolcante rooks and the pluton yield's Mb-Sr whole-rook tapchard age of 99.9 £ 2.2 m.y. with an initial \$57.9 m.g. o.7001. Major-element waristion diagrams of the pluton and volcante rooks define coincident compositional trends.

The pluton, intruded into Early Juressia metamorphosad volcanic rooks (Mb-Sr ugidle, got isochron age of 185 ± 6 m.y., initial \$7.9 m² o.70074 ½ 0.00003), is composed of a central body of grantic that is intruded into and almost completely surrounded by a crascant-shaped outer rim of quartz monzodicrite. Contact rolations between the grantic tracks, intrusive in some places and completely grystellized prior to the intrusion of the grante. Modal mineralogy within the pluton is also consistent with this inferred crystallization history. The grantic rock tenures are extendedly. The grantic rock accordance is age; grain of foldspar, hornblends, and bioute. Midely spaced oplice dives from the grantic Index associated with myrawkite in the pluton, being undeformed, indicate along the contact between the grantiu rocks. The aplite dives and interaticial sizel related associated with myrawkite in the pluton, being undeformed, indicate along the contact between the grantic rocks and completely approach of the sail monume of the grantic indicate associated with myrawkite in the pluton, being undeformed, indicate along the contact between the grantic rocks as and completely approach of the sail monume of the grantic rocks. The aplite dives and interacticinal sizel related as associated with myrawkite in the pluton, being undeformed, indicate along the contact between the grantic rocks. ocapositions suggest a minimum crystallization pressure of 0.5 bb (1.2 km); this doptn is consistent with crystallization man the base of a large structvoicano. The pluton is characterized by steep, linear functures, defined by mineral clots and inclusions, that probably formed during the upward government of the nearly crystallized magns in the voicencies conduit.

J. Geophym. Res., Rel. Paper 180901

42no Paragonesta, potrografic, and potrolenesta HEMICAL EVOLUTION OF MACHAS IN THE PROTECTION TERRALS OF THE ST. PRANCED MONTAINS, MODIFICALISTES MISSOURI, USA, PART OF FILIP. PRIBOGRAPHIC, AND MODO ELEMENT DATA H. B. Birliott Oppartment of modific, "Indecative of Parago, Lawrence, "Fanal, 1980 I P. Sides and R. L. Cullers

4260 Paragamesis, petrography and petrogenesis SECCHEMISTRY AMD PETROLOGY OF MID-TERTIARY ASK-FLOW THES FERM FILE SIERRA EL VIRULENTO AREA, EASTERN CHIMANNA, MESICO E. J. Moll (U.S. Geological Survey, 345 Middle-field Rd., Menlo Park, CA 94025)

The Sierra el Virulento, located in the Mexican Basin and Range province of eastern Chimanna, is cooposed of over 700 m of siliceous high-K calcalledic ash-flow kuff ranging in age from 33.7 ± 0.3 to 29.5 ± 0.5 m.y. At least 703 of phenocrysts in the tuffs are zoned feldspar crystals that have andesine tores and anorthoclass riws. Subordinate phenocrysts include clinopyroxene, biotile, ilmenite, ampetite, sanidine, horn-

blende, quartz, and orthopyrosene. Pyroxenss are Mg-rich and have a restricted range of Mg-Fe ratios. Fe-II oxide pinerals equilibrated at high temperatures (880-1055°C) and oxygen fugactites (-10g f0g - 8.3-II.0]. The tuffs are strongly enrichted in light rare earth elements (18EE) and have moderate negative Eu anomalies. Initial 875r/805r ratios range from 0.7043 to 0.7045 and show a rough corrolation with 5102, 5r, and Rh/5r. The Sr-isotopic compositions suggest that the rocks formed from an isotopically hetrogeneous source material and ware modified by later crustal contamination. Dacite tuffs may have originated by either fractional trystallization af more mafic magnas or by partial malting of crustal material. The series dictie to rhyolite seems to have evolved by a co-bination of low-pressure fractionation in shallow magna charbers and crustal interaction. If variations from dacite to rhyolite are the result of crystal fractionation, the mineralogy and major-element date Suggest that angriboclase was the dominant fractionating phase.

J. Geophys. Res., Red., Faper 180905

4260 Petroganesis of granite magnas CHEMICAL EVOLUTION OF MAGNAS IN THE PROTEROZOIC TERRAME OF THE ST. FRANCOIS MOUNTAINS, SOUTHEAST-EARN MISSOURI, U.S.A., PART [I: TRACE ELEMENT

EARN MISSOURI, U.S.A., PART [I: TRACE ELEMENT DATA
R.L. Culiars (Department of Goology, Kansas State University, Panhattan, Kansas 66506, U.S.A.)
R.J. Yook, M.E. Bitford
The St. Francois Mumitains Igneous complex of Proterozoic age consists of hypabyssal, grenite plutons intruded into the overlying rhypistes of similar age. Melting and crystallization models of these rocks suggested by the field, petrographic, and major element contents are further refined using Rb. Ra. Sr. REE (rare-earth element). Th. Sc. and Co contents. There are two groups of relatively undifferentiated plutons associated with the Butler Hill caldera and Taur Sauk area that could have formed by partial relating of lower crustal rocks. The plutons associated with the Butler Hill caldera (problick and Silvernine grantes) could have formed by about 301 aggregate melting of a quertz diorite, gray-macke, or subgraywacte. The plutons associated with the Taum Sauk area could have formed by about 301 equilibrium calting of a subsrious or arbose.

Aere silicic rocks of the Outlor Hill caldera could have formed by state of the could have formed by arbose.

arbose.

More sificic rocks of the Outlor Hitl caldera could have formed by fractional crystallization. The Silvernine Granite is internity zoned. Crystallization of plaginclase/bintstop/born-blende/cagnelite/aratice/zircon/sphene in a ratio of 0.70/0.10/0.05/0.05/0.05/0.05/0.007/for the least differentiated portion of the Silvernine Granite could have formed intermediate portions of the Silvernine. Further crystallization of the Silvernine Further crystallization of the Silvernine requires more blotte (88 begins to increase) and less horn-blende, zircon, and sphone (MRE increase) to precipitate and form the rost differentiated portions. Also fractional crystallization of undifferentiated Silvernine-type cagnus could have produced the sequence of Rutler Hill-Breafray/Graniteville Granites as residual liquids respectively. The cally crystallizing onlineral assemblane is deminated by quality in plagicates and bioties while the late crystallizing oneral assemblane is deminated by quality, h-feldman, and leaves obsolved are. The Gweissold Grandion tell in the Mean Fack area has the chersed associated valcanic rocks could not have formed from the Silvernine Granited-file differentiation sequence.

The associated valcanic rocks could not have formed from relix of valcely the same cryposition of any of the associated intrusive rocks bather the collegist of valcely the same cryposition of any of the associated intrusive rocks bather the collegist of valcely the same cryposition of slightly different chemistry.

J. Georgia. Res., Red. Paper 180202

4290 Himaratory, Petrology and Crystal Chemistry THE DAM EXAMINATION OF MEDICACION SAMPLES WITH A SEMICONDUCTOR BACKSCATTERED ELECTRON DETECTOR N.C. Hall Identic for Hararials Science

University of Birtingham, P.O. Box 101. Birtingham Bis 2TT, U.L.1 G.E. Lioyd The paper describes the use of the back-scattered electron (BSE: mode of scanning elec-The paper describes the use of the tackreatered electron (BER) mode of scanning electron microscope (SER) operation for mineralogical
and earth schences applications. Such of scratter
requires an efficient detector system and of the
types presently available the one described here
an annular shiften dieded gives comparable if
not superior results to the commercially system. Other
BER detectors constructed from photodiodes are
also found to give good results and are inexpensive and simple to manufacture. Several sepects
of BER large quantification are considered. It
is shown how extent number contrast (which arises
from the dependers of the BER coefficients on
composition) may be calculated and the BER coefficients for a wide range of common minerals are
presented. Atomic number contrast quives rise to
only a small proportion of the total large signal
and in order to remove other sources of contrast
special attention should be paid to specimen
preparation. Carbon coaling is found to be the
text method of preventing the specimen from
charqing because unlike other methods (e.g. gaid
coating, environment cell it does not interface with image detail or X-vay enalysis. The costing, environmental call) it does not inter-fare with image destil or X-ray analysis. The paper shows how compositional information and mireral proportions may be obtained from sometiments, outside the analysis of the architecture of the transfer of the architecture. Architecture is a sometiment of the architecture of the architecture of the architecture of the architecture.

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4230 Experimental mineralogy and petrology FOTENTIAL FOR GEOCHEMICAL EXPERIMENTS IN LARGE SCALE LESTS (including renges of streams, pore fluid pressures and compositions, and temperatures R. J. Vidale (Mes Hapes Haifens) laboratory, Group GNC-7, NS 314, Les Alusos, See Hexica 87343, USA). Geochemical problems that would benefit from